CSU Degree Program Proposal

Program for Applied Biotechnology Studies (PABS)

Master of Biotechnology (MBt)

Department of Biological Science
California State Polytechnic University, Pomona

in association with other departments and campuses in PABS

1. Program Type (Please specify any from the list below that apply—delete the others)

✓ State-Support
✓ Self-Support
✓ Fast Track

2. Program Identification

a. Campus:

California State Polytechnic University, Pomona

b. Full and exact degree designation and title (e.g. Master of Science in Genetic Counseling, Bachelor of Arts with a Major in History).

Master of Biotechnology (MBt)

c. Date the Board of Trustees approved adding this program projection to the campus Academic Plan.

March, 2008

d. Term and academic year of intended implementation (e.g. Fall 2007).

Fall, 2009

e. Name of the department(s), division, or other unit of the campus that would offer the proposed degree major program. Please identify the unit that will have primary responsibility.

The Department of Biological Science will offer the program and will have primary responsibility for overseeing the degree program.

f. Name, title, and rank of the individual(s) primarily responsible for drafting the proposed degree major program.

Program Directors:

Dr. Jill Adler-Moore, Professor of Biology, Department of Biological Sciences, is the primary drafter of this document for California State Polytechnic University, Pomona. Dr. Adler-Moore has been one of the faculty liaisons of the Intercampus Coordination Team (ICCT) that has worked with the Program for Applied Biotechnology Studies (PABS) at California State University Fullerton (CSUF) to help develop this intercampus MBt.

Dr. David Dyer who will be housed at CSUF will be the Program Director for the intercampus MBt as part of PABS. He will coordinate the intercampus activities for the MBt.

Intercampus Collaboration Team:
Because the degree will be emulated across all four campus partners in PABS (see Section 3 below for more details on PABS) there are faculty liaisons on each campus who form the Intercampus Collaboration Team (ICCT). The PABS ICCT has led the faculty workshops responsible for creating the curriculum defined below.

These additional individuals are:

- Professor Jill Adler Moore (Pomona)
- Professor Sandra Sharp (Los Angeles)
- Assistant Professor Howard Xu (Los Angeles)
- Professor Getachew Kidane (Dominguez Hills)
- Professor Robert Koch (Fullerton)

The PABS Deans Group:

This group has been active in solving the issues of an administrative nature and has developed a Memorandum of Understanding that will define the process by which PABS will share faculty and students among the four southern California campuses (see Attachment F: Business Plan Documents and PRBC Form). These individuals are:

- Dean Steven N. Murray (College of Natural Sciences and Mathematics, CSUF)
- Associate Dean Mark Filowitz (College of Natural Sciences and Mathematics, CSUF), replacing recently-retired David Fromson
- Dean Jose Galvan (Graduate Studies & Research, CSULA)
- Associate Dean Alan Muchinski (Graduate Studies and Research, CSULA)
- Dean James Henderson (Natural and Social Science, CSULA)
- Dean Donald Straney (College of Science, CPP)
- Dean Charles Hohms, (College of Natural and Behavioral Science, CSUDH)

g. Statement from the appropriate campus administrative authority that the addition of this program supports the campus mission and will not impede the successful operation and growth of existing academic programs. (CPEC “Appropriateness to Institutional and Segmental Mission”)

Please see Attachment A, Deans Support Letters

h. Any other campus approval documents that may apply (e.g. curriculum committee approvals).

Please see Attachment B, Curriculum Approval Documents, for these documents which will be updated as the proposals move through each campus’ process.

i. Please specify whether this proposed program is subject to WASC Substantive Change review.

This proposal is not subject to WASC Substantive Change review, because we are not proposing more than 50% of the Units to be taken on a given campus. Although the greatest distance between campuses is from CPP to CSUDH (36.4 miles), the Chancellor’s Office (via Christine Hanson) has determined that is not significant enough to drive a review since the percentage is less than 50%.

j. Optional: Proposed Classification of Instructional Programs (CIP) Code and CSU Degree Program Code. Campuses are invited to suggest one CSU degree program code and one corresponding CIP code.

CIP = 26.1201 Biotechnology
Program Code = 04991 Biotechnology

3. Program Overview and Rationale
a. Rationale, including a brief description of the program, its purpose and strengths, fit with institutional mission, and a justification for offering the program at this time. The rationale may explain the relationship among the program philosophy, design, target population, and any distinctive pedagogical methods. (CPEC “ Appropriateness to Institutional and Segmental Mission”)

Rationale: The Professional Science Master’s (PSM) degrees have been recognized as a solution to the looming shortages in the supply of a technically trained workforce in California (1, 2) and in the nation (3,4). This degree provides a path to rewarding careers for science, technology, engineering, and mathematics (STEM) majors; therefore it has the long term potential to diminish the alarming decline in the percentage of students entering these majors since the mid-seventies (3). While the first wave of PSM programs established was aimed at research universities, the Sloan Foundation is currently targeting master’s level institutions, which produce 40% of the master’s degrees in science and mathematics in the nation (5). The California State University (CSU) system is well positioned for offering PSM degrees; it is the largest public university in the nation offering terminal master’s degrees (Carnegie “Master’s L” institutions (6)), with many campuses located within the “California Innovation Corridor” where there is a concentration of technology companies and a supportive infrastructure for innovation (7). The CSU Chancellor’s Office (CO) is committed to supporting the development of PSM programs at select CSU campuses based on the positive results of surveys that demonstrate regional workforce needs and students’ interest (1,2,8), the first steps in planning for PSM programs (9). The workforce analysis indicated the types of industries in several major regions of California and identified those that would be expanding with increasing need for a technical workforce (2). The Sloan Foundation is supporting the CSU CO’s initiative to coordinate the development of new PSM programs in three regional areas within the California Innovation Corridor: in Northern California, in San Diego, and in the Los Angeles Basin, to which the PABS consortium of four CSU campuses belongs (10).

Robertson, G. (2005), “Report on Survey of Professional Science Master’s Interest Among California State University Undergraduate Students”, California State University, Fullerton Social Science Research Center, Fullerton, CA. (currently unpublished, will be posted on CSU PSM website).

Brief Description of the Program: The Program for Applied Biotechnology Studies (PABS) is to be offered by a consortium of four southern California CSU campuses including: California State University Fullerton (CSUF), Cal Poly Pomona (CPP), California State University Dominguez Hills (CSUDH), and California State University Los Angeles (CSULA). The PABS degree will be the Master of Biotechnology (MBt) and will be awarded by the
Biology Department on each of the four campuses to the students “homed” at that campus. As can be seen from the curriculum (outlined in Section 4 below), each campus will house at least one core course and at least one set of advanced courses that will compose the Concentrations.

The PABS curriculum will focus on preparing graduates for the workforce in biotechnology companies where knowledge of molecular and cellular biology, mathematical modeling, mining of biological databases, engineering concerns in the production of biomedical products including pharmaceutical and biodevices as well as business management, regulatory affairs, and finance are important aspects of success. Students with bachelor’s degrees in molecular or cellular biology, biochemistry, applied mathematics, engineering, computer science or business and an interest in working in companies involved in these areas are candidates for acceptance into the program.

The PABS curriculum begins in the first semester with a *Survey of Biotechnology*—a collection of four mini-segments that will provide students with the competencies they need to become communicative members of biotechnology industry teams. This *Survey of Biotechnology* will be followed by a series of three modularized biotechnology laboratory skills training courses (the *Biotechnology Skills I, II and III Series*) in the first (I), second (II) and third (III) semesters of the program. These will provide a hands-on opportunity to learn about some of the major concepts and tools introduced in the survey courses. During the second semester, students will also take core courses in regulatory affairs/clinical trial management, and project management. In the summer between the first and second years, each student will participate in an internship in a biotechnology company where they will gain first-hand exposure to the operation of a biotechnology company. During the third and fourth semesters, students will declare a Concentration and take three additional designated courses, and will complete a team-based applied project that will have been submitted by a partnering biotechnology company. A committee of faculty and representatives from the company will evaluate the success of this project on the basis of a written project report and a private (for confidentiality purposes if necessary) and public presentation (modified if necessary) during a PABS symposium.

Purpose and Strengths: The granting of the MBt professional science master’s degree through PABS (acting through the Department of Biological Science at Cal State Fullerton as the agent), addresses the specific needs (as defined in Rationale above and the references cited) of the biomedical device, bio-agricultural, medical diagnostic, and biopharmaceutical industries that depend on biotechnology for development and manufacturing of their products. These industries are particularly strong in California where 50% of the world’s biotechnology companies exist.

Collaboration has been integral to PABS activities—not only have we collaborated across departments and colleges on an individual campus, but across campuses in the CSU. In addition, PABS faculty have collaborated with local industry representatives in the planning phase of PABS and the curriculum being proposed. This collaboration is critical to the mission of PABS and will be fostered in the on-going modifications of PABS to keep it current and oriented to the needs of industry. Industry representatives from several biotechnology and medical device businesses have participated in workshops designed to hone the curriculum, define concentrations relevant to biotechnology companies, and identify courses that would best serve the needs of industry. Over the course of five such collaborative planning workshops, the companies involved have included: Allergan, Ambry Genetics, Amgen, Bausch and Lomb, Beckman-Coulter, Edwards LifeSciences, Eyeconics, Gilead, Irvine Scientific, Mannkind Corporation, Medtronic, Molecular Express, Valeant Pharmaceuticals, Watson Pharmaceuticals, and WSP Environmental Strategies.

Executive-level business participants from research and development, regulatory, and quality assurance departments assisting in these efforts have expressed the highest degree of
support and enthusiasm for the program. We expect these close ties to industry to yield significant opportunities for internships and the practical applied PSM team projects that PABS students will undertake as well as to identify adjunct faculty who will participate in the teaching of some of our core courses.

Fit with Institutional Mission: The PABS Master of Biotechnology (MBt) will meet the following CPP mission, goals and strategies. The mission of CPP is "to advance learning and knowledge by linking theory and practice in all disciplines, and to prepare students for lifelong learning, leadership and careers in a changing multicultural world."

Goal 1: To promote excellence in teaching, learning and educational programs, and
Goal 4: To enhance support for students.

This program is intended for students interested in combining their undergraduate major with a solid understanding of the six disciplines associated with biotechnology (molecular biology and biochemistry, analytical chemistry, applied mathematics and computer science, medical device engineering, business, and regulatory/quality assurance) and required to prepare students to work on teams in the biotechnology-related industries.

To a large extent, employees, especially those in middle management, work in multi-disciplinary teams and need to be familiar with the primary elements of each discipline; i.e., each member of the team needs to understand the basic knowledge underpinning the discipline of each other team member and know the language of those disciplines well enough to communicate effectively with each team member. The Survey in Biotechnology core course will orient the students to the fundamentals of commercialization, cell and molecular biology, physiology and toxicology, mathematical modeling, database management, bioinformatics, and the technology of biomedical devices and biopharmaceuticals. The Biotechnology Skills Series (I, II and III) will do the same for the basic instrumentation approaches used in many biotechnology companies. The Clinical Trials/Regulatory Affairs course will broaden each student’s awareness of key rules governing the progress and development of any biotechnology product, and the Biotechnology Project Management course will focus the student’s attention on a key activity of middle management and improve her/his participation on a team whether as a team member or a team leader.

Goal 2: To enhance effective acquisition, planning and management of resources.

The essential element of the PABS curriculum (indeed PABS itself) is collaboration. Students will work in teams in all parts of the Survey of Biotechnology, Biotechnology Skills Series and in their MBt Thesis Projects. Because one of the primary goals of the MBt is to develop teamwork skills, it focuses on the opportunity to be part of a team and is built into 50% of the curriculum.

Goal 3: To promote and enhance research, scholarly, professional and creative activities.

PABS is clearly a unique approach to scholarly and creative activities compared to the traditional approach for most math, science and business students, and is more aligned with the technology approach of a typical engineering or computer science department. Traditional MS thesis research in science departments involves research, often by a sole individual, of basic questions, whereas the PABS MBt project will address a practical, industrially relevant problem, using an interdisciplinary team approach. During the second year, each student will complete a thesis project using the concepts and skills they have mastered in the first year of the program and in their intervening summer as a result of their Applied Biotechnology Internship, based on real-world problems submitted by partnering biotechnology companies. Students will work in teams to investigate and offer solutions to the problems or objectives inherent in the project. Each student will be responsible for a specific aspect of the team approach, making it possible for him/her to complete an individual culminating MBt project report. The development of skills in acquisition of knowledge from publicly available information (information literacy) will be integrated into the core curriculum, the internship, and the project.
Goal 5: To improve the campus environment, and
Goal 6: To increase community involvement.

As noted above, the biotechnology industry is an essential partner in the PABS collaboration—the critical role they will play in sponsoring internships, submitting MBt thesis projects, naming company liaisons to work with the student teams assigned their project, having employees acting as adjunct professors, and serving as members of an Advisory Board will increase the connections between the University and the biotechnology community. These connections and the movement of our graduates into the biotechnology companies will contribute to the economic stability of the industry and the overall intellectual development of the region. We also hope to interest larger companies in sponsoring student scholarships and making other resources available to support PABS.

The alignment of PABS Student Learning Goals with specific courses is described in Section 4a below and outlined in Table 2 below. The success of the program will be measured by the following quantitative indicators: (1) the number of high quality applications received; (2) the number of companies that submit internship opportunities; (3) the number of projects submitted by the biotechnology industry; and, (4) the number of graduates who secure jobs in the biotechnology industry. In addition, we will develop survey instruments to collect opinions from students and from the biotechnology industry about the overall program. Finally, there will be special surveys for the companies that provide internships and thesis projects to assess the performance of our students in those venues and the satisfaction of the company with the student’s products.

Justification for Offering the Program at this Time: Student interest was tested by a feasibility study that was co-funded in 2004 by the Alfred P. Sloan Foundation and CSU Chancellor’s Office and that underlies the development of PABS. A student interest survey was conducted on 15 of the CSU campuses by the Social Science Research Center at Cal State Fullerton. The results of this survey, the highlights of which are provided below under Section 6a, indicate a robust student interest in this type of program.

Industry interests were also assessed by this study. Industry respondents, which included company operations and human resource executives, provided valuable insight into strengths of expanding the PSM degree programs. Key observations from principals included:

- Any program increasing overall number of STEM graduate degrees is seen as positive
- Addition of business-related coursework is valuable
- Inclusion of internships is attractive, though dependent on program
- Companies welcome increased university-industry interaction (via advisory boards)
- PSM is one of several logical and needed evolutionary steps in the development of interdisciplinary graduate degrees

Overall, the environment in California for our students to be employed in the biotechnology industry is strong. The 2006 report on California’s biomedical industry released by the California Healthcare Institute indicates that the biotechnology sector is a rapidly growing employer in California. California now has more than 2,700 biomedical companies offering nearly 260,000 jobs spending more than $18.2 billion on wages (California Biomedical Industry Is Now Second Largest Driver of State’s High Technology Economy; Surpasses Motion Picture, Telecom and Computer Industries in Employment, 19 October 2006, accessed 15 Sep 2008, http://www.chi.org/news/archive.aspx?year=2006).

A 2002 study by the California Council on Science and Technology report (Critical Path Analysis of California’s Science and Technology Education System) includes in its recommendations for master’s level science and technology education the exploration of “… a two-year post-graduate entry degree…along the lines of the MBA.” This is precisely what the
PABS MBt degree proposes to be with its inclusion of a practical business orientation for many of its courses.

b. Proposed catalog description, including program description, degree requirements, and admission requirements. For master’s degrees, please also include catalog copy describing the culminating experience requirement(s).

The Master of Biotechnology (MBt) Degree

The Master of Biotechnology (MBt) is a professional science master’s degree that will educate the future leaders of the biotechnology industry. The curriculum is offered through the Program in Applied Biotechnology Studies (PABS), a consortium of four member CSU campuses, Los Angeles, Fullerton, Pomona, and Dominguez Hills. The two-year program provides thorough training not only in the science and skills fundamental to the industry, but also in essential business, information literacy, communication, project management, cross-functional teamwork and group leadership skills. Students will have the opportunity to specialize in one of six concentration areas, including:

- Applications of Molecular Biology/Biochemistry to Biotechnology
- Applications of Analytical Chemistry to Biotechnology
- Applications of Regulatory Affairs/Quality Assurance to Biotechnology
- Applications of Engineering to Biotechnology
- Applications of Business/Law to Biotechnology
- Applications of Informatics/Biomathematics to Biotechnology

In addition, students will obtain valuable business skills and experience by interning with leading biotechnology and biomedical device companies in the Southern California region, and through their capstone MBt project. This culminating experience includes the completion of a team-based project, an individually written project report, and a team-based presentation of the project findings.

Applicants must meet the university requirements for admission, which include a baccalaureate from an accredited institution and a grade-point average of at least 3.0 in the last 60 Quarter units attempted (see Cal Poly Pomona catalog section on Graduate Admissions for complete statement and procedures). Students must make two applications, one to the university and another to the department. In addition to the university requirements for admission, acceptance into this program is contingent upon the following:

1. A B.A. or B.S. from an accredited institution with a grade-point average of 3.0 in major courses in one of the following areas:
   - Biological Science or related area
   - Engineering or related area
   - Chemistry or related area
   - Business or related area
   - Mathematics or related area

2. Submission of scores on one of the following: (a) Graduate Record Examination General Test, (b) Medical College Admission Test, (c) Dental Admission Test, or (d) GMAT; (3) completion of the departmental application; (4) submission of two letters of recommendation.

Curriculum

a. Goals for the (1) program and (2) student learning outcomes. Program goals are very broad statements about what the program is intended to achieve, including what kinds of graduates will be produced. Student learning outcomes are more specific statements that are related to the program goals but that more narrowly identify what students will know and be able to do upon successful completion of the program.
(1) Program
The Master of Biotechnology (MBt) degree to be offered by the Department of Biological Sciences will prepare graduates for the workforce in biotechnology companies where knowledge of molecular and cellular biology, mathematical modeling, mining of biological, chemical, and other informational databases, engineering concerns in the creation of biomedical products including pharmaceutical and biomedical devices as well as skills like project management, regulatory affairs, and clinical trial management are important aspects of success. Graduates will be prepared to function successfully in multidisciplinary teams created to move products from concept to market in companies using biotechnology approaches.

Students with bachelor’s degrees in molecular or cellular biology, biochemistry, applied mathematics, engineering, computer science or business and an interest in working in companies involved in these areas are candidates for acceptance into the program.

(2) MBt Student Learning Outcomes

Information Literacy Skills
A MBt student shall be able to:
• Determine what kind of information is needed to solve a problem.
• Identify how to obtain the relevant information from literature/information databases.
• Critically assess the information for its rigor.
• Cite the information gathered appropriately in written and oral formats.

Communications Skills
A MBt student shall be able to:
• Work effectively as a member of an interdisciplinary team.
• Converse with colleagues in all disciplines related to the mission of the MBt.
• Write and present project proposals and technical reports that communicate effectively with all levels of an organization.
• Communicate effectively with individuals in governmental and public entities.

Content Knowledge
A MBt student shall be able to:
• Demonstrate knowledge in a primary area of expertise.
• Identify and critically evaluate the literature in the primary area.
• Understand the basic processes of product life cycles.

Applications
A MBt student shall be able to:
• Demonstrate mastery of basic application skills in biotechnology disciplines.
• Develop experimental or practical designs for solving problems in product or process development.
• Analyze the driving forces for product development.
• Use knowledge effectively in new situations and diverse contexts.

For easy reference, Table 1 below summarizes the MBt curriculum with an indication of Units and locations of instruction. Details of the organization and logistics are discussed in subsequent sections. See Attachment C, 3-yr Course Scheduling for details of location and timing.
Table 1. PABS Master of Biotechnology (MBt) Curriculum (40 Semester Units/60 Quarter Units—need to check this!!)

***Note: Academic units are presented as Semester Units/Quarter Units.***

See Attachment C, 3-yr Course Scheduling for details of location and timing of courses.

<table>
<thead>
<tr>
<th>Year 1</th>
<th>First Semester (12/18 Units)</th>
<th>Second Semester (9/13.5 Units)</th>
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<tr>
<td></td>
<td><em>Survey of Biotechnology:</em></td>
<td><em>Biotech Skills I (3/4.5):</em></td>
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<td></td>
<td><em>Part A. Commercialization of</em></td>
<td><em>Applications</em></td>
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<td></td>
<td><em>Biotechnology (3/4.5);</em></td>
<td><em>Training Modules</em></td>
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<td></td>
<td>[with an integrated Workshop*</td>
<td>{Homed at CSULA in winter quarter}</td>
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<td></td>
<td><em>in Information Literacy]</em>*</td>
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<td></td>
<td>{both components of Part A*</td>
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<td><em>during orientation prior to</em></td>
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<td>*start of fall quarter}</td>
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<td><em>Part B. Molecular Biology</em></td>
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<td></td>
<td><em>and Pharmacology/Toxicology</em></td>
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<td><em>Part C. Mathematical</em></td>
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<td><em>Modeling and Bioinformatics</em></td>
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<td><em>(3/4.5)</em></td>
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<td><em>Part D. Pharmaceuticals and</em></td>
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<td></td>
<td><em>Biomedical Device Technology</em></td>
<td><em>(3/4.5)</em></td>
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<td><em>{Homed at CSUF in fall}</em></td>
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<td><strong>Year 2</strong></td>
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<td>Third Semester (9/13.5 Units)</td>
<td>Fourth Semester (9/13.5 Units)</td>
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<td><em>Biotech Skills III (3/4.5):</em></td>
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<td><em>Applications</em></td>
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<td><em>Training Modules</em></td>
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<td><em>{Homed at CSUDH}</em></td>
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<td></td>
<td><em>MBt Project (3/4.5)</em></td>
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<td><em>{Home campus}</em></td>
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<td></td>
<td><em>Courses in Concentration</em></td>
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<td><em>(3/4.5-6/9)</em></td>
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<td><em>{Home campus}</em></td>
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<td>Summer</td>
<td>Applied Biotechnology Internship (1 unit)</td>
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<td>Applied Biotechnology Internship (1 unit)</td>
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<td>(Selection of thesis project topic and committee)</td>
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</table>

# A total of 6 Semester/9 Quarter Units will count toward degree.

* A total of 9 Semester/13.5 Quarter Units.

**To be offered at CSUF and coordinated by Catherine Haras, MLiS in collaboration with librarians from other PABS campuses. Ms. Haras is an Information Literacy specialist from CSULA.

*Concentrations (See Attachment H for selected courses from each campus.)*

- Applications of Molecular Biology/Biochemistry to Biotechnology
- Applications of Analytical Chemistry to Biotechnology
- Applications of Regulatory Affairs/Quality Assurance to Biotechnology
- Applications of Engineering to Biotechnology
- Applications of Business/Law to Biotechnology
- Applications of Informatics/Biomathematics to Biotechnology

b. Plans for assessing program goals and student learning outcomes. Some planners find it helpful to develop matrices in which student learning outcomes and required courses are mapped.
indicating where content related to the learning outcomes is introduced, reinforced, and practiced at an advanced level in required courses. (CPEC “Maintenance and Improvement of Quality”)

Table 2. Correlation of Learning Outcomes with Courses offered in Curriculum.

<table>
<thead>
<tr>
<th>Student Learning Outcome</th>
<th>Courses that will achieve this outcome</th>
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<tbody>
<tr>
<td><strong>Information Literacy Skills</strong></td>
<td></td>
</tr>
<tr>
<td>• Determine what kind of information is needed to solve a problem</td>
<td>Information Literacy Workshop&lt;br&gt;Survey of Biotechnology A-D&lt;br&gt;Biotech Skills I-III&lt;br&gt;Project Management&lt;br&gt;Applied Biotechnology Internship&lt;br&gt;MBt Project</td>
</tr>
<tr>
<td>• Identify an approach to obtaining the relevant information from literature/information databases</td>
<td>Information Literacy Workshop&lt;br&gt;Survey of Biotechnology A-D&lt;br&gt;Biotech Skills I-III&lt;br&gt;Project Management&lt;br&gt;Applied Biotechnology Internship&lt;br&gt;MBt Project</td>
</tr>
<tr>
<td>• Critically assess the information for its rigor AND • Cite the information gathered appropriately in written and oral formats</td>
<td>Written and oral reports in:&lt;br&gt;Information Literacy Workshop&lt;br&gt;Survey of Biotechnology A-D&lt;br&gt;Biotech Skills I-III&lt;br&gt;Project Management&lt;br&gt;Applied Biotechnology Internship&lt;br&gt;MBt Project</td>
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<tr>
<td><strong>Communications Skills</strong></td>
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<tr>
<td>• Work effectively as a member of an interdisciplinary team.</td>
<td>Survey of Biotechnology A-D&lt;br&gt;Biotech Skills I-III&lt;br&gt;Project Management&lt;br&gt;Applied Biotechnology Internship&lt;br&gt;MBt Project</td>
</tr>
<tr>
<td>• Converse with colleagues in all disciplines related to biotechnology.</td>
<td>Survey of Biotechnology A-D&lt;br&gt;Biotech Skills I-III&lt;br&gt;Applied Biotechnology Internship&lt;br&gt;MBt project&lt;br&gt;MBt project presentation</td>
</tr>
<tr>
<td>• Write and present project proposals and technical reports that communicate effectively with all levels of an organization.</td>
<td>Survey of Biotechnology A-D&lt;br&gt;Biotech Skills I-III&lt;br&gt;Project Management&lt;br&gt;Applied Biotechnology Internship&lt;br&gt;MBt project&lt;br&gt;MBt project presentation</td>
</tr>
<tr>
<td>• Communicate effectively with individuals in governmental and public entities.</td>
<td>Clinical Trials and Regulatory Affairs&lt;br&gt;Biotech Skills I-III&lt;br&gt;Courses in Concentration</td>
</tr>
<tr>
<td>Content Knowledge</td>
<td>MBt project presentation</td>
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<td>----------------------------------------------------------------------------------</td>
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<tr>
<td>• Demonstrate knowledge in a primary area of expertise.</td>
<td>Applied Biotechnology Internship Courses in Concentration MBt project MBt Project Presentation</td>
</tr>
<tr>
<td>• Identify and critically evaluate the literature in the primary area.</td>
<td>Courses in Concentration MBt Project MBt Project Presentation</td>
</tr>
<tr>
<td>• Understand the basic processes of product life cycles.</td>
<td>Survey of Biotechnology Part A: Commercialization of Biotechnology</td>
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<tr>
<td>Applications</td>
<td></td>
</tr>
<tr>
<td>• Demonstrate mastery of the basic application skills in biotechnology disciplines</td>
<td>Applied Biotechnology Internship MBt Project</td>
</tr>
<tr>
<td>• Develop experimental or practical designs for solving problems in product or process development</td>
<td>Survey of Biotechnology A-D Biotech Skills I-III Project Management Applied Biotechnology Internship MBt Project Courses in concentration</td>
</tr>
<tr>
<td>• Analyze the driving forces for product development</td>
<td>Survey of Biotechnology A-D Project Management Clinical Trials/ Regulatory Affairs Courses in Concentration</td>
</tr>
<tr>
<td>• Use knowledge effectively in new situations and diverse contexts.</td>
<td>Applied Biotechnology Internship MBt project Survey of Biotechnology A-D</td>
</tr>
</tbody>
</table>

b. Total number of Units required for the major; total number of Units required to graduate.

The Master of Biotechnology (MBt) is a 40 semester/ 60 quarter-unit professional science master’s degree.

c. Include a justification for any baccalaureate program that requires more than 120-semester Units or 180-quarter Units.
   Not applicable.

d. If any formal options, concentrations, or special emphases are planned under the proposed major, identify and explain fully. Optional: You may propose a CSU degree program code and CIP code for each concentration that you would like to report separately from the major program, if the option is approximately equivalent to a degree currently listed on the CSU application-booklet degree program.
Concentrations offered in the MBt Degree:
- Applications of Molecular Biology/Biochemistry to Biotechnology
- Applications of Analytical Chemistry to Biotechnology
- Applications of Regulatory Affairs/Quality Assurance to Biotechnology
- Applications of Engineering to Biotechnology
- Applications of Business to Biotechnology
- Applications of Informatics/Biomathematics to Biotechnology

e. A list of all courses required for the major, specifying catalog number, title, Units of credit, and prerequisites or co-requisites (thereby ensuring that there are no “hidden” prerequisites that would drive the total Units required to graduate beyond the total reported in 4c above).

Note: The pre-requisite requirements of all MBt required courses will be waived in each department for MBt students (see Attachment G, Other Support Letters). Units presented as Semester Units/Quarter Units.

1. BIOL 573, Survey of Biotechnology, Part A: Commercialization of Biotechnology. No prerequisites. 3/4.5 Units. CSUF.  {Department approval in progress.}
2. BIOL 570, Survey of Biotechnology, Part B: Molecular Biology and Pharmacology/Toxicology. No prerequisite. 3/4.5 Units. CSUF.
3. MATH/BIOL 571, Survey of Biotechnology Part C: Mathematical Modeling and Bioinformatics. 3/4.5 Units. CSUF
4. CPSC/BIOL 572, Survey of Biotechnology Part D: Pharmaceuticals and Biomedical Device Technology. 3/4.5 Units CSUF
5. BIOL 518, Biotechnology Skills I: Applications Training Modules in Drug Discovery. 3/4.5 Units. CSULA.
6. EGR 500, Biotechnology Skills II: Applications Training in Medical Devices. 1/1.5 Units. CPP. (Department level approval in progress)
7. BIO 576. Regulatory Affairs for the Biotechnology Industry 2/3 Units. CPP {College of Science approval in progress.} NOTE: This is a 2/3-unit course as required to meet the 40/60-unit total for the MBt degree. **
8. GBA 636 Project Management. 2/3 Units. CPP. NOTE: This is a 2/3-unit course as required to meet the 40/60-unit total for the MBt degree.
9. BIOL 580, Special Topics. 1/1.5 unit. {This course will be used as the vehicle to offer the Applied Biotechnology Internship as listed in Table 1.} CPP.
10. BIOL 522, Biotechnology Skills III: Applications Training Modules. 3/4.5 Units. CSUDH
11. BIOL 598, Thesis. 3/4.5 Units. CPP. {These Units will be used to meet the MBt Project (2) and MBt Writing and Presentation (1) as specified in Table 1.}

** The new course proposals are in the University approval process. Because these new courses have already entered the approval process, pending unforeseen problems, they will be available to the first cohort of students enrolled in the program in Fall 2009.
f. List of elective courses that can be used to satisfy requirements for the major, specifying catalog number, title, Units of credit, and prerequisites or co-requisites. Include proposed catalog descriptions of all new courses. For graduate program proposals, identify whether each course is a graduate or undergraduate offering.
Note: With regard to Sections 4f and 4g, a proposed program should take advantage of courses already offered in other departments when subject matter would have considerable overlapping content.

MBt Degree Concentrations:
(Courses to be offered at CPP are listed below. Courses to be offered at the other campuses may be found in Attachment H, Concentration Courses at Other Campuses.)

Courses in the Concentrations for the MBt that have prerequisites will be met by the students bachelor’s degree work. Students will be advised to select Concentrations in which they have basic course work completed. Generally, the choice to add a new field of expertise will require taking some prerequisites.

Applications of Biotechnology to Regulatory and Clinical Trials

**EGR 402** Ethical Considerations in Technology and Applied Science (4). Prerequisite: One GE course from each of the following Sub areas: A1, A2, A3 and B2, B3 and C2

**AVS 545** Design and Analysis of Experimental Research (4) Prerequisite: any course in statistics

**GBA 636** Project Management (3) Prerequisite: Microcomputer proficiency and

**STA 534** Linear Statistical Models II (4) Prerequisite: C or better in STA 533 or consent of instructor

Applications of Biotechnology to Analytical Chemistry

**CHM 424/424L** Organic Analysis (2,2) Prerequisite: Minimum grade of D in CHM 221/221L, and minimum grade of C in CHM 316 and D- in 319L

**CHM 451/451L** Enzymology (3,1) Prerequisite: CHM 329/329L

**STA 420** Nonparametric Statistics (4) Prerequisite: C or better in STA 210 or STA 326 or STA 341, or consent of instructor

**STA 432** Applied Regression Analysis (4) Prerequisite: C or better in STA 326 or STA 341 and MAT 208 or consent of instructor

**STA 435** Analysis of Variance and Design of Experiments (4) Prerequisite: C or better in STA 326 or STA 341 or STA 441 or consent of instructor

Applications of Biotechnology to Molecular Biology/Biochemistry

**AVS 430/430L** Biotechnology Applications in Animal Science (3,1) Prerequisite: Management Science Courses, AVS 350/350L, BIO 303 or AVS 305 or AVS 345
FI 426/426L Diseases of Fruit Crops (3,1) Prerequisite: BOT 323/323L. Concurrent enrollment required
BIO 403/403L Human Genetics (3,1) Prerequisite: BIO 211 and BIO 303
BIO 424 Neuroscience (4) Prerequisite: BIO 115/115L (or the series of BIO 121/121L, 122/122L and 123/123L); and CHM 201/250L or CHM 314/317L
BIO 450 Concepts of Molecular Biology (4) Prerequisite: BIO 310 or CHM 32
BIO 459/459L Bioinformatics (3,2) Prerequisite: BIO 303
BIO 535 Advanced Cell Biology (4) Prerequisite: BIO 435/435L and CHM 327/327L
BIO 545/545L Physiology of Plant Disease (3,1) Concurrent enrollment required. Prerequisite: BOT 323/323
BIO 548/548L Advanced Plant Physiology (2,2) Prerequisite: BOT 428/428L
BIO 550/550L Plant Growth and Development (2,2) Prerequisite: BOT 428/428L
BIO 555 Molecular Biology of Development (4) Prerequisite: Graduate Standing Required
BIO 560/560L Advanced Bacterial Physiology and Genetics (3,1) Concurrent enrollment required. Prerequisites: MIC 300/300L and CHM 327/327L
BIO 570/570L Cellular Immunity and Disease (3,1) Prerequisite: MIC 415/415L
BIO 581/581L Transport Across Cell Membranes (3,2) Prerequisite: BIO 428/428L or ZOO 428/428L, CHM 329/329L, PHY 123/123L or 133/133L
BOT 403/403L Plant Genetics (3,1) Prerequisite: BIO 303, BOT 124/124L (or the series of BIO 121/121L, 122/122L and 123/123L)
BOT 428/428L Plant Physiology (3,2) Prerequisite: the series of BIO 121/121L, 122/122L and 123/123L; or BOT 424/424L
BOT 440/440L Diagnosis and Control of Plant Disease (2,2) Prerequisite: BOT 323/323L
BOT 441/441L Methods in Plant Pathology (2,2) Prerequisite: BOT 323/323L
BOT 456/456L Plant Tissue Culture (2,2) Prerequisite: BOT 422/422L
MIC 410/410L Medical Bacteriology (3,2) Graduate Standing
MIC 415/415L Immunology-Serology (3,2) Prerequisite: the series of BIO 121/121L, BIO 122/122L, and BIO 123/123L
MIC 428/428L Microbial Physiology (3,2) Prerequisite: MIC 201/201L; CHM 201 and CHM 250L (or CHM 314, 315, 316, and 317L)
MIC 430/430L General Virology (3,2) Prerequisite: MIC 428/428L
CHM 451/451L Enzymology (3,1) Prerequisite: CHM 329/329L
CHM 453 Recombinant DNA Biochemistry (3)
CHM 417 Computational Biochemistry (4) Prerequisite CHM 305 or 313

Applications of Biotechnology to Biomathematics/Statistics
CIS 415 Advanced Object-oriented Systems Analysis and Design (4) Minimum grade of C (2.0) in CIS 305 and CIS 328
GBA 522 Information Systems Analysis and Design (4) Prerequisite: Graduate Standing
CS 530 Advanced Algorithm Design and Analysis (4) Prerequisite: CS 331 or equivalent
CS 531 Computability and Complexity Theory (4) Prerequisite: CS 311 and CS 331, or consent of instructor
CS 535 Parallel and Distributed Algorithms (4) Prerequisite: CS 331 or consent of instructor.
CS 560 Bioinformatics for Computer Scientists (4) Prerequisite: CS 420 or consent of instructor
CS 565 Advanced Computer Networks (4) Prerequisite: CS 380 or consent of instructor
CS 566 Distributed Computing Systems (4) Prerequisite: CS 380 and CS 431, or consent of instructor
CS 575 Topics in Database Systems (4) Prerequisite: CS 435 or consent of instructor
CS 580 Advanced Software Engineering (4) Prerequisite: CS 480 or equivalent
CS 585 Software Verification and Validation (4) Prerequisite: CS 480 or consent of instructor
EGR 511 Numerical Modeling (4) Prerequisite: Undergraduate course in numerical analysis or consent of instructor
EGR 549 Advanced Methods in Operations Research (4) Prerequisite: Upper-division course in operations research
MAT 431, 432 Differential Equations (3/4.5 and 3/4.5) Prerequisites: C or better in MAT 216 and 208 or consent of instructor
MAT 470 Combinatorics (3/4.5) Prerequisites: C or better in MAT 208 or consent of instructor
MAT 545, 546 Modeling (4,4) Prerequisite: consent of instructor
MAT 570 Graphs and Network Flows (3/4.5) Prerequisites: MAT 370 or consent of instructor
MAT 580 Optimization Theory and Applications (4) C or better in MAT 480 or consent of instructor.
STA 533 Linear Statistical Models I (4) Prerequisite: C or better in STA 432 or consent of instructor.
STA 534 Linear Statistical Models II (4) Prerequisite: C or better in STA 533 or consent of instructor.
STA 584 Queueing Theory (4) Prerequisite: C or better in STA 430, and STA 341 or STA 441, or consent of instructor
BIO 459/459L Bioinformatics (3,2) Prerequisite: BIO 303
CHM 420 Computational Chemistry (3,1) Prerequisite: CHM 313, MAT 216
CSA 411/411A General Systems Theory I: Processes (3,1) Prerequisite: Graduate Standing
CSA 412/412A General Systems Theory II: Linkages (3,1) Prerequisite: CSA 411/411A
CSA 413/413A General Systems Theory III: Artificial Systems Research (3,1) Prerequisite: CSA 412/412A
CSA 440 General Systems Modeling and Simulation (4) Prerequisite: CSA 303 or 304
CSA 450 Comparative Systems Analysis I (4) Prerequisite: CSA 300
CSA 451/451L Comparative Systems Analysis II (3,1) Prerequisite: CSA 450
CSA 470 Applied Ecosystems Engineering (4) Prerequisite: BIO 325/325L; CSA 413/413A
CHM 417 Computational Biochemistry (4) Prerequisite: CHM 305 or 313

Applications of Biotechnology to Business

GBA 535 Organizational Management, Principles and Behavior (4) Prerequisite: Graduate Standing
GBA 546 Fundamentals of Financial Management (4) Prerequisite: GBA 510, GBA 514, and EC 521 and computer proficiency
GBA 640 Total Quality Management (3) Prerequisite: Concurrent enrollment in GBA 641 required. Unconditional standing required
GBA 667 Organizational Development (4) Prerequisite: GBA 615 and GBA 616. Unconditional standing required
GBA 683 Business Research Methods (3) Unconditional standing required. Prerequisites: Completion of all MBA core courses and microcomputer proficiency. Concurrent enrollment in GBA 684 required.
FRL 401 Government Regulation of Business (4) Prerequisite: FRL 201
FRL 470 Risk Management and Insurance (4) Prerequisite: Graduate Standing
IBM 408 Marketing Research I (4) Prerequisites: IBM 320 and TOM 302.
MHR 417 Total Quality Management Implementation (4) Prerequisite: TOM 401
MHR 423 Creating A Business Plan (4) Prerequisites: MHR 320 or EBZ 306
MHR 425 Emergent Ventures (4) Prerequisite: MHR 320 or EBZ 306
TOM 411 Strategic Management (4) Prerequisite: ACC 207/207A, ACC 208/208A, MHR 301, IBM 301, FRL 300, FRL 301, CIS 310, TOM 301, and TOM 302
TOM 420 Operations Technologies and Strategies (4) Prerequisite: TOM 301
TOM 425 Supply Chain Design, Analysis and Representation (4) Prerequisite: TOM 301 and microcomputer proficiency
TOM 434 Purchasing Management (4) Prerequisite: TOM 301.
ECON 501 Quantitative Methods for Business Decision – Making (4) Prerequisite: CIS 100 or equivalent
FIN 435 Working Capital Management (4) Prerequisites: ACCT 300, ECON 309, FIN 303
BUS 501 High Perf. Mgmt: Communication, Teamwork, and Leadership (4) Corequisite: BUS 502A
BUS 511 Managerial Skills and Business Ethics (4) Graduate Standing
MGMT 468 Small Business Management (4) Graduate Standing
MGMT 470 Managerial Leadership and Motivation (4) Prerequisite: MGMT 307
BUS 511 Managerial Skills and Business Ethics (4) Graduate Standing
Applications of Biotechnology to Engineering

AG/BUS/EGR/SCI 481,482 (2) Prerequisites: One GE course from each of the following Sub-areas: A1, A2, A3 and B1, B2, B3 and upper division standing
EGR484/SCI484 Science and Technology Seminar (4) Prerequisite: One GE course from each of the following Sub-areas: A1, A2, A3 and B1, B2, B3
EGR461/462/463 Engineering Interdisciplinary Studies (3) Prerequisite: En 104
ARO419 Computational Fluid Dynamics (4) Prerequisite: C or better in ARO 301. Corequisite: ARO 311.
ARO436 Mech Compos Material (4) Prerequisite: C or better in ARO 327
CS445 Computer Graphics (4) Prerequisite: CS241 and CS256 or consent of instructor
CS481 Software Engin Practice (4) Prerequisite: CS 435 and CS 480 or consent of instructor
MTE408/418L Intro Comp Mat (3,1) Prerequisite: MTE 207 and MTE 317L (or ME 315 and ME 350L).
MTE422 Fracture/Failure Analysis (4) Prerequisite: MTE 207 (or ME 315); and MTE317L (or ME 350L).
ECE414L Microproc Appl Proc Co (1) Prerequisite: Corequisite: ECE 414
ECE 415 Digital Des Verilog HDL (3) Prerequisite: ECE 341/341L and ECE 256. Corequisite: ECE415L.
ECE 419 Adv Control Systems (3) Prerequisite: ECE 309
ECE 426 Oper Sys Embed Appl (3) ECE 256 and ECE 425/425L or ECE 342/342L or ECE 343/343L. Corequisite: ECE 426L
ECE 428 Digital Sign ProcessII (4) Prerequisite: ECE 408
ME 415 Heat Transfer (4) Prerequisite: C– or better in either MAT 216 or MAT 224, ME 301 and ME 311.
CS 565 Adv Compu Networks (4) Prerequisite: CS 380 or consent of instructor.
ECE 552 Intro Neural Networks (3) Prerequisites: ECE 341/341L and ECE 256. Corequisite: ECE 415L.
ECE 588 Biolog Control Systems (4) Prerequisite: Graduate Student Standing
ECE 592L Microcontrol App II Lab (2) Prerequisite: Graduate Student Standing
MTE 421 Materials Charac Testing (4) Prerequisite: MTE 327/L
ECE 412 Integ Circuits: Dev Model (4) Prerequisite: ECE 330
ECE 432 Microprocessor II (3) Prerequisite: ECE 343/343L or ECE 341/341L. Concurrent 432L
ECE 435L BiomedInstru Meas Lab (1) Corequisite ECE 435L
IE 419 Reliability Concepts/Tech (3) Prerequisite: IME 312
ECE 414 Microproc Appl Proc Cont (3) Prerequisite: ECE 309, ECE 341/341L, and ECE 306; Concurrent: ECE 414L.
ECE 435 Biomed Instru Meas (3) Prerequisite: Bio 100, Corequisite ECE 435L

g. List of any new courses that are: (1) needed to initiate the program and (2) needed during the first two years after implementation. Only include proposed catalog descriptions for new courses. For graduate program proposals, identify whether each course is a graduate-level or undergraduate-level offering.

(see Attachment E, New Course Proposals)

Survey of Biotechnology Series
BIOL 573, Survey of Biotechnology, Part A: Commercialization of Biotechnology. No prerequisites. 3/4.5 Units. CSUF. {Department approval in progress}
BIOL 570, Survey of Biotechnology, Part B: Molecular Biology and Pharmacology/Toxicology. No prerequisites. 3/4.5 Units. CSUF. {University approval granted.}

BIOL 571, Survey of Biotechnology Part C: Mathematical Modeling and Bioinformatics. No prerequisites. 3/4.5 Units. CSUF. {University approval granted.}

BIOL 572, Survey of Biotechnology, Part D: Pharmaceuticals and Biomedical Device Technology. 3/4.5 Units. No prerequisites. CSUF. {University approval granted.}

**Biotechnology Skills Series**

BIOL 518, Biotechnology Skills I: Applications Training Modules in Drug Discovery. 3/4.5 Units. No prerequisite. CSULA. {University approval granted}

EGGN 500, Biotechnology Skills II: Applications Training in Medical Devices. 1/1.5 unit. CPP. {Department level approval in progress}

BIOL 522, Biotechnology Skills III: Applications Training Modules. 3/4.5 Units. CSUDH {University approval granted.}

**Clinical Trials**

BIOL 576, Clinical Trials/Regulatory Affairs: Regulatory Affairs for the Biotechnology Industry. 2/3 Units. No prerequisites. CPP. {College of Science approval in progress}.

h. Attach a proposed course-offering plan for the first three years of program implementation, indicating, where possible, likely faculty teaching assignments. See Attachment C, 3-yr Course Scheduling and Attachment F, Business Plan, worksheet 3.

j. For master’s degree proposals, include evidence that program requirements conform to the minimum requirements for the culminating experience, as specified in Section 40510 of Title 5 of the California Code of Regulations.

Admission criteria, curriculum, units, MBt project, and minimum GPA as described in this document all conform to Section 40510 of Title 5. This document is the evidence.
k. Admission criteria, including prerequisite coursework.

**Overview:** Because the MBt program offers a wide range of concentration paths, applicants from a wide range of disciplines are invited to apply. However, because of the rigorous nature of the MBt training program, the applicant’s practical experience, and career aspirations will be important factors in applicant selection. A major in the life sciences, mathematics, engineering, computer science or business is likely to provide the most thorough academic preparation for the MBt program.

**Criteria:** Applicants must meet the university requirements for admission, which include a baccalaureate from an accredited institution and a grade-point average of at least 3.0 in the last 60 Quarter unit attempted (see section of the CPP catalog on Graduate Admissions for complete statement and procedures). Students must make two applications, one to the university and another to the department. In addition to the university requirements for admission, acceptance into this program is contingent upon the following:

1. A B.A. or B.S. from an accredited institution with a grade-point average of 3.0 in major courses in one of the following areas:
   - Biological Science or related area
   - Engineering, Computer Science or related area
   - Chemistry, Biochemistry or related area
   - Business, Management, Information Science or related area
   - Mathematics or related area

2. Submission of scores on one of the following: (a) Graduate Record Examination General Test, (b) Medical College Admission Test, (c) Dental Admission Test, or (d) GMAT or related test; (3) completion of the departmental application; (4) submission of two letters of recommendation.

l. Criteria for student continuation in the program.

   Adequate progress through the program, with the student maintaining a cumulative GPA of not less than 3.0

m. For undergraduate programs, planned provisions for articulation of the proposed major with community college programs.

   Not applicable

n. If there is a Lower-Division Transfer Pattern (LDTP) for this major, indicate the relationship between the LDTP and the requirements presented in this proposal. Information on LDTP is available at: http://www.calstate.edu/AcadAff/ldtp.shtml

   Not applicable

o. Advising “roadmaps” that have been developed for the major.

   Admitted graduate students will meet with the PABS Program Director (PD) in a MBt Orientation Session during the spring or summer preceding the onset of their program. At that time students will become acquainted with the goals and objectives of PABS and the MBt and the flow of students through the MBt curriculum (see Attachment F, Business Plan, PABS Logistics). Each academic quarter, MBt students at CPP will meet with the PD or PABS/MBt campus liaison prior to registration to ensure that they are progressing appropriately. Because the program will be run on a cohort model, the movement of students should be synchronous.
Intense advising will occur near the end of the first academic year when Applied Biotechnology Internships are selected, and when consideration of MBt Projects will begin. Courses for the Concentration will also be selected during the first spring quarter of the program for the CPP students. Early in the second year of the program, the MBt Projects will be definitively selected and teams named. There will never be more than two cohorts of students in the program and we anticipate that no more than 24 students (one lab section’s worth) will enter in any cohort.

p. Provision for meeting accreditation requirements, if applicable, and anticipated date of accreditation request (including the WASC Substantive Change process).

Accreditation Note:

*Master’s degree program proposals*

If subject to accreditation, establishment of a master’s degree program should be preceded by national professional accreditation of the corresponding bachelor’s degree major program.

(Accreditation note finished on next page.)

*Fast-track proposals*

Fast-track proposals cannot be subject to specialized accreditation by an agency that is a member of the Association of Specialized and Professional Accreditors unless the proposed program is already offered as an authorized option or concentration that is accredited by an appropriate specialized accrediting agency.

Not applicable.

5. Need for the Proposed Degree Major Program
   (CPEC “Societal Need,” “Number of Existing Programs in the Field,” and “Advancement of the Field”)

   a. List of other California State University campuses currently offering or projecting the proposed degree major program; list of neighboring institutions, public and private, currently offering the proposed degree major program.

   A critical element for the success of a PSM program is its ability to access biotechnology businesses as a source of internships and financial support. California has been a magnet for biotechnology and biomedical device innovation, and leads the nation in venture capital investments in this arena. The California biotechnology corridor is ideal for the planting and growth of applied biotechnology workforce development programs, including the MBt degree in applied biotechnology studies. Accordingly, there are several programs in California that offer training in this regard.

   The CSU has 14 planned or in-place PSM programs. These programs operate on single campuses. Examples include San Jose State University’s Master of Biotechnology (MBt) degree program, which integrates advanced, hands-on training in laboratory-based core biotechnologies from the College of Science with MBA-level business courses in management/marketing from the College of Business at San Jose State University.

   CSU Channel Islands has an active PSM program in Biotechnology and Bioinformatics in place, with Amgen as the principal supporting biotech business for the program. Additionally, there are a number of certificate programs in the geographic regions surrounding the PABS-PSM consortium campuses. These programs encompass the certificates offered through C-LAB, the CSU Program for Education and Research in Biotechnology consortium of the 8 LA Basin campuses. CSULA also offers a post-baccalaureate Certificate Program in Biotechnology. Its
primary goal is to prepare students for work as wet-bench research associates in life science research in biotechnology, with emphasis on critical research skills and application of molecular techniques.

California State University, Fresno offers a Certificate of Advanced Study Program in Biotechnology. This intensive, one-year post-baccalaureate program emphasizes molecular biology and a wide range of current laboratory skills used in biotechnology.

The oldest program in the area resides at the Keck Graduate Institute (KGI). This two-year program in applied life sciences culminates in the professional Master of Bioscience degree. Designed to educate leaders for the biotechnology, pharmaceutical, healthcare product and bioagricultural (biosciences) industries, Keck Graduate Institute’s interdisciplinary curriculum integrates biological systems, computational biology and bioengineering with management, finance and bioethics. KGI’s applied research programs focus on commercializing new discoveries in the life sciences to create products and processes beneficial to society.

Other relevant non-CSU programs include the MS in Biotechnology program offered at University of California, Irvine. This program is similar to our existing research-based MS in Biological Science with an emphasis in molecular or cellular biology, but lacks any special focus on the biotechnology industry and does not include any elements of business or commercialization.

b. Differences between the proposed program and programs listed in Section 5a above.

The concept of a professional master’s degree is relatively new in the country. Because of this novelty, the presence of several programs in a state or particular geographic region has not been seen as competitive, but rather as supportive of local and national efforts to raise the visibility of the professional science master’s degree in general. Even in this light, the PABS MBt degree program possesses several very unique features.

i. Cost and Access: The high cost of most professional science master’s degree programs can present a significant barrier to broad student access. As a state-supported program, the PABS MBt will be accessible to all students regardless of financial status. As a multi-campus collaboration, the PABS MBt eliminates the need for redundancy and lowers cost accordingly. The program is designed to facilitate the sharing of training resources and personnel. The consortium model allows students at a small CSU campus, like Dominguez Hills, to participate in a program that would otherwise be too costly. At the same time, it allows larger campuses to focus on areas of existing expertise and to take advantage of the expertise at sister institutions. Each of these features make the program available to students at the cost of a traditional CSU master’s degree.

ii. Business Access: The geographic distribution of the consortium campuses, which encompasses the broad biotech corridor stretching from Los Angeles County to Orange County, facilitates access to companies that wish to make use of the program to support their own extended education initiatives. This feature is important where travel is often complicated because of heavy traffic and/or fuel cost considerations, and may further encourage industrial experts who wish to participate as instructors in the program.

iii. Focus on Engineering: Recently the Sloan Foundation has revised the scope of the Professional Science Master’s program to include engineering disciplines. In addition to its anticipated recruitment of students with a background in the life sciences and in contrast to a good number of the professional science masters programs in the United States, the PABS MBt will actively recruit students with backgrounds in mathematics and engineering disciplines. We anticipate that the teamwork between students trained
in engineering and in the life sciences will greatly facilitate cross-discipline communication and foster innovation.

iv. Other Considerations: The Keck Graduate Institute and San Jose State degrees offer multiple subjects and some training that involves team-based learning, but these programs are more expensive than the PABS MBt. The PABS MBt differs from the Fresno State program, as the latter is heavily focused on agricultural biotechnology. The UCI program is basically a repackaging of courses used in other graduate programs and does not have the business- and technology-oriented courses of the PABS MBt. Finally, the PABS multi-campus consortium model program is the first of its kind in the nation.

c. List of other curricula currently offered by the campus that are closely related to the proposed program.

The PABS MBt is related to the undergraduate Biotechnology major in the Biological Sciences Department. The undergraduate major is an interdisciplinary program which provides students with a strong background in both biology and chemistry. It provides the theoretical and practical knowledge needed to understand the numerous industrial applications of biological phenomena, while emphasizing the study of cell and molecular biology. Students can select their upper division electives from six clusters: (1) Physiology; (2) Molecular Biology and Genetics; (3) Microbiology and Pathology; (4) Biochemistry and Molecular Separation Techniques; (5) Agriculture; and (6) Business. This program is for undergraduates and will not compete with the PABS MBt. In fact, this program can be seen as being synergistic.

d. Community participation, if any, in the planning process. This may include prospective employers of graduates.

One of the main objectives of the MBt program is to produce students who are technically well grounded and who have a strong sense of how that technical training relates to the business world. Industrial specialists have been a key resource in all stages of planning the MBt degree, as they provided a reliable reality check on the overall utility of the program. As noted earlier, we have carefully nurtured these industrial relationships, making sure to solicit and incorporate industrial guidance in the process of establishing and shaping the curriculum, defining areas of student specialization, and in identifying relevant courses to support concentrations. Several key areas for industrial participation are envisioned for the MBt:

1) Continued program curriculum review and refinement
2) Provision of case studies for student analysis
3) Provision of internships
4) Provision of instruction for sections of courses relevant to the expert’s experience
5) Provision of financial support for the program overall
6) Participation of select industrial members in the PABS MBt Advisory Board

e. Applicable workforce demand projections and other relevant data.

Today, US biotechnology firms employ between an estimated 146,000 to more than 187,000 workers. By 2015, the industry may employ as many as 250,000 or more, particularly if cross-disciplinary innovation in the biologics and medical devices industries follows its present growth trend. The job multiplier is about 1.9 for biotechnology, meaning that almost two additional jobs result from every biotechnology job created. US Dept of Labor projects that between 2002 and 2012, US employment in the Life Sciences will grow by 18%. Employment is predicted to grow by 19% for biological scientists, 19% for biological technicians, and 23% for workers in pharmaceutical and medical device manufacturing. In a recent address to the President’s Council of Advisors on Science and Technology, Michael S. Teitelbaum, a demographer at the Alfred P.
Sloan Foundation, indicated that professional science master’s degrees more closely match the expectations of employers in the biotech and medical device industries than the traditional master’s or Ph.D. degrees, which are geared for academic research.

f. If the program was proposed to meet society’s need for the advancement of knowledge, please specify the need and explain how the program meets that need.

Recently, the size and adequacy of the national workforce for carrying out scientific, technical, engineering, and mathematics (STEM) activities in the United States have become areas of concern in many policy circles. Knowledgeable sources both inside and outside of government have voiced fears that this workforce is aging and may soon face a dwindling labor pool, a problem that could be compounded by skill shortages in key areas and a growing proportion of non-U.S. citizens obtaining STEM degrees in the United States. The PABS-MBt program is designed to meet the growing demand for highly trained individuals in the biotechnology business community. Providing such a workforce will help the US maintain an internationally competitive edge in this arena, will help the US economy overall, and will facilitate greater innovation and discovery for the general betterment of the human condition.

Note: Other Data Sources for Demonstrating Evidence of Need

APP Resources Web http://www.calstate.edu/app/resources.shtml
US Department of Labor, Bureau of Labor Statistics
California Labor Market Information Labor Forecast

6. Student Demand (CPEC “Student Demand”)

a. Compelling evidence of student interest in enrolling in the proposed program. Types of evidence vary and may include national, statewide, and professional employment forecasts and surveys; petitions; lists of related associate degree programs at feeder community colleges; reports from community college transfer centers; and enrollments from feeder baccalaureate programs, for example.

Student interest was tested by a feasibility study that was co-funded in 2004 by the Alfred P. Sloan Foundation and the CSU Chancellor’s Office and that underlies the development of PABS and this MBt program. A student interest survey was conducted on 15 of the CSU campuses by the Social Science Research Center at Cal State Fullerton.

Students in STEM and related majors were asked to complete an online survey about their interest in a PSM program. There were 2,190 respondents, the equivalent of approximately 7.5% of the STEM majors on the participating campuses. The attributes of the respondents mirrored the 2004-05 CSU STEM majors in gender (slightly more males than females) and ethnicity (most common race indicated by respondents was Caucasian, next was Asian, followed by Latino, and last African American). Disproportionate numbers of respondents were seniors (55.6%), and the cumulative GPA in their major (3.18) was higher than the average CSU STEM major. Survey respondents represented a population of CSU students particularly likely to be interested in and eligible for Master's degree study in a STEM field.

Surveyed students were asked about plans to enter graduate school. Just less than half (46.3%) planned to enter graduate school immediately, while 39.8% planned to work for a year or more first. Of those planning to attend graduate school, most (51.5%) intended to pursue a doctorate degree while close to half intended to earn Master’s degrees (45.9%) and a small percentage (2.6%) planned to earn a teaching credential.
Overall, 52.5% of the surveyed CSU STEM majors answered that they would be “somewhat likely” or “very likely” to enroll in a PSM degree program if it were offered. Students intending to earn a Master’s degree stated that they were more likely to enroll in a PSM degree program than those students planning to earn a teaching credential or doctorate. Also, students in certain academic majors (e.g., Biochemistry, Computer Science and Biology) were the most likely to enroll in a PSM degree program.

Given the option of a PSM degree or a traditional Master of Science (MS) degree, a slightly higher proportion of CSU science students indicated that they would pursue a MS degree (52.3%) rather than a PSM degree (47.7%). However, 78.5% of students indicated that they would pursue a PSM degree over a non-science master’s degree (such as a Master in Business Administration or a Master in Public Administration).

CSU science students rated the attractiveness of a list of PSM degree programs. The main reasons for their interest in PSM and their mean rating is depicted in Table 3.

### Table 3: Attractiveness of PSM Programs

<table>
<thead>
<tr>
<th>How attractive to you are these potential elements of a Professional Science Master's Degree Program?</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Academic training with a strong real-world component</td>
<td>3.38</td>
</tr>
<tr>
<td>Doing an internship in industry that might lead to a job offer instead of doing an academic thesis</td>
<td>3.36</td>
</tr>
<tr>
<td>Work on real-world problems directly relevant to current product development in industry</td>
<td>3.33</td>
</tr>
<tr>
<td>PSM graduates are likely to earn higher pay in multidisciplinary positions that may suffer from a shortage in the workforce</td>
<td>3.26</td>
</tr>
<tr>
<td>Multidisciplinary training to prepare for a wider range of careers</td>
<td>3.21</td>
</tr>
<tr>
<td>Preparation for the workforce rather than preparation for academe</td>
<td>3.17</td>
</tr>
<tr>
<td>The PSM degree as an alternative for people who love science, but do not see themselves taking the Ph.D./MS Track</td>
<td>3.08</td>
</tr>
<tr>
<td>Experts predict that the PSM will become the fast track to management positions in business and government</td>
<td>3.06</td>
</tr>
<tr>
<td>Degree program with course work in leadership and team building</td>
<td>2.96</td>
</tr>
<tr>
<td>Working with other students on business-oriented projects</td>
<td>2.83</td>
</tr>
<tr>
<td>A degree program including courses in business and management</td>
<td>2.75</td>
</tr>
</tbody>
</table>

“1” corresponds to “Very unattractive” and “4” to “Very attractive”

Using the same scale, CSU science students “not at all likely” or “somewhat unlikely” to enroll rated their agreement with five potential reasons for their lack of interest in a PSM degree (see Table 2).

### Table 4: Reasons for Not Enrolling in a PSM Degree Program

<table>
<thead>
<tr>
<th>If you are “Not at all likely” or “Somewhat likely” to enroll in a PSM Degree Program, is this because...</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>The PSM is relatively new, and I’m not sure how it might affect my career</td>
<td>2.45</td>
</tr>
<tr>
<td>I intend to enter the workforce directly after earning my</td>
<td>2.35</td>
</tr>
</tbody>
</table>
I have plans to enter a Ph.D. program after completing my bachelor’s degree  2.27
Unwilling to pay fees at a higher level than charged by the CSU for a conventional master’s degree  2.23
I intend to do academic research, so I would prefer to do a thesis, rather than an internship  1.96

(1=Strongly Disagree, 4=Strongly Agree)

Though significantly less concordant than the “attractiveness” data, student concerns that the PSM program is relatively new, and perhaps risky or unstable, reinforces the need to advertise the PSMs, providing high-level visibility while also ensuring high quality. But, the fact that the existing PSM programs in California that have been in effect the longest continue to show robust enrollments, suggests that student demand for the program is substantial, consistent with national demand. (see http://www.sciencemasters.com).

Industry interests were also assessed by this study. Industry respondents, which included company operations and human resource executives, provided valuable insight into the strengths of expanding the PSM degree programs. Industry respondents perceived that the strengths of developing and expanding PSM degree programs included:

- Any program increasing overall number of STEM graduate degrees is seen as positive
- Addition of business-related coursework is valuable
- Inclusion of internships is attractive, though dependent on program
- Companies welcome increased university-industry interaction (via advisory boards)
- The PSM is one of several logical and needed evolutionary steps in the development of interdisciplinary graduate degrees

Overall, the environment in California for our students to be employed is strong. The 2006 report on California’s biomedical industry released by the California Healthcare Institute indicates that the biotechnology sector is a rapidly growing employer in California. California now has more than 2,700 biomedical companies offering nearly 260,000 jobs spending more than $18.2 billion on wages (California Biomedical Industry Is Now Second Largest Driver of State’s High Technology Economy; Surpasses Motion Picture, Telecom and Computer Industries in Employment, 19 October 2006, accessed 15 Sep 2008, <http://www.chi.org/news/archive.aspx?year=2006>).

A 2002 study by the California Council on Science and Technology report (Critical Path Analysis of California’s Science and Technology Education System) includes in its recommendations for master’s level science and technology education the exploration of “… a two-year post-graduate entry degree…along the lines of the MBA.” This is precisely what the PABS MBI degree proposes to be including the practical business orientation of many of its courses.

b. Issues of access considered when planning this program.

This program will be made available to both continuing education students and matriculated students at all four campuses in the PABS Consortium (Fullerton, Dominguez Hills, Los Angeles and Cal Poly Pomona). The distribution of the program across the LA Basin is considered to improve overall access to students from these two sources.

The availability of access to matriculated students at the usual graduate student rates is unusual for a high-cost, specialized program like this. The PABS Deans and Faculty feel strongly that this level of access is critical to the mission of all the campuses. At the same time,
the availability of access via Open University will allow those who prefer not to matriculate (usually employees whose tuition is being covered by the employer) can participate as well.

c. For master’s degree proposals, the number of declared undergraduate majors and the degree production over the preceding three years for the corresponding baccalaureate program, if there is one.

<table>
<thead>
<tr>
<th>Number of Majors (Fall Census Data)</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Administration (all majors)</td>
<td>4202</td>
<td>4228</td>
<td>4243</td>
</tr>
<tr>
<td>Electrical and Computer Engr</td>
<td>1206</td>
<td>1142</td>
<td>1091</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>994</td>
<td>1003</td>
<td>1123</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>1014</td>
<td>1045</td>
<td>1116</td>
</tr>
<tr>
<td>Chemistry</td>
<td>146</td>
<td>169</td>
<td>169</td>
</tr>
<tr>
<td>Computer Science</td>
<td>576</td>
<td>522</td>
<td>519</td>
</tr>
<tr>
<td>Math</td>
<td>221</td>
<td>248</td>
<td>274</td>
</tr>
<tr>
<td>Physics</td>
<td>52</td>
<td>60</td>
<td>76</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Number of Degrees Awarded (whole academic year)</th>
<th>2005</th>
<th>2006</th>
<th>2007</th>
</tr>
</thead>
<tbody>
<tr>
<td>Business Administration (all majors)</td>
<td>1119</td>
<td>1196</td>
<td>1132</td>
</tr>
<tr>
<td>Electrical and Computer Engr</td>
<td>248</td>
<td>232</td>
<td>201</td>
</tr>
<tr>
<td>Mechanical Engineering</td>
<td>74</td>
<td>98</td>
<td>102</td>
</tr>
<tr>
<td>Biological Sciences</td>
<td>149</td>
<td>177</td>
<td>184</td>
</tr>
<tr>
<td>Chemistry</td>
<td>17</td>
<td>21</td>
<td>26</td>
</tr>
<tr>
<td>Computer Science</td>
<td>99</td>
<td>87</td>
<td>84</td>
</tr>
<tr>
<td>Math</td>
<td>27</td>
<td>35</td>
<td>44</td>
</tr>
<tr>
<td>Physics</td>
<td>12</td>
<td>12</td>
<td>5</td>
</tr>
</tbody>
</table>

Source: Cal Poly Pomona Office of Research and Graduate Studies

d. Professional uses of the proposed degree program.

The program will provide highly trained workers with a keen sense of project management and teamwork needed for the biotechnology and medical device business sector. In addition, the program will be available to interested California biotech and medical device businesses for
internal employee development. As company-sponsored continuing education programs are widely recognized to support trained workforce retention, we are pleased, but not surprised, at having received enthusiastic support from the business community. In addition, the program will provide additional trained workers for this industrial sector.

e. The expected number of majors in the year of initiation and three years and five years thereafter.

The expected numbers of graduate students in the year of initiation, and three years and five years thereafter are:

- Year 1: 20 Majors
- Year 3: 42 Majors
- Year 5: 48 Majors

7. Existing Support Resources for the Proposed Degree Major Program
   (CPEC “Total Costs of the Program”)

**Note:** Sections 7 and 8 should be prepared in consultation with the campus administrators responsible for faculty staffing and instructional facilities allocation and planning. A statement from the responsible administrator(s) should be attached to the proposal assuring that such consultation has taken place.

a. Faculty who would teach in the program, indicating rank, appointment status, highest degree earned, date and field of highest degree, professional experience, and affiliations with other campus programs. For master’s degrees, include faculty publications or curriculum vitae.

**Note:** For all proposed graduate degree programs, a minimum of five full-time faculty members with the appropriate terminal degree should be on the program staff.

(Code Memo EP&R 85-20)

(see **Attachment D, Faculty CVs**)

**Pomona:**
- Department of Biological Sciences
  - Professor Jill Adler Moore
  - Assistant Professor Weijen Lin
- Department of Engineering
  - Professor Winnie Dong

**Fullerton:**
- Department of Biological Science
  - Professor Robert Koch
  - Professor Marcelo Tolmasky
  - Assistant Professor Nilay Patel
  - Assistant Professor Math Cuajungco
- Department of Chemistry and Biochemistry
  - Professor Maria Linder
- Department of Mathematics
  - Associate Professor Mori Jamshidian
  - Assistant Professor Angel Pineda
- Department of Computer Science
  - Assistant Professor Spiros Courelis
- Department of Management
  - Professor Ellen Dumond
b. Space and facilities that would be used in support of the proposed program.

Sufficient laboratory and teaching space is available to the program at each of the four PABS campuses.

c. A report provided by the campus Library, detailing resources available to support the program (discussion of subject areas, volume counts, periodical holdings, etc. are appropriate).

Library feedback on proposed PABS Master of Biotechnology (James S. Koga, Cal Poly Pomona)

- General issues:
  - Only those students who are currently enrolled in credit-bearing classes at Pomona will be able to access Cal Poly Pomona University Library-licensed databases and electronic resources from off-campus and many of the relevant electronic resources will be held by all CSU Libraries in common and therefore accessible via remote access from the home CSU campus. Since projects will be team-based, this is not viewed as an issue by the college, although the library wishes it to be clearly understood by all teaching in the program.

  - Interlibrary loan of books or articles not held by the Cal Poly Pomona Library is only available to students currently enrolled in credit bearing classes at Cal Poly Pomona. All CSU libraries do provide this service for their enrolled students. Again, since projects will be team-based, this is not viewed as an issue by the college, although the library wishes it to be clearly understood by all teaching in the program.

- Resources (subject to qualifications noted above):
  - Particularly relevant electronic materials:
    - ABI/INFORM Global
    - Biological Abstracts
    - ACM Digital Library
    - American Chemical Society Publications
    - Biological Abstracts
    - Business Full Text
    - Compendex (Engineering Index)
    - EconLit
    - Factiva
    - Hoover’s Company Records
    - IEEE Explore
    - Kirk-Othmer Encyclopedia of Chemical Technology
    - Lexis Nexis Academic
    - MathSciNet
    - MEDLINE / PubMed
    - Mergent Online
    - ScienceDirect
    - Merck Online
- ScienceDirect
- S&Ps Net Advantage Industry Surveys
- Wiley Interscience
  - Under the general category “Life Sciences” the Cal Poly Pomona University Library holds at least some issues of 1830 electronic or paper periodicals. Particularly relevant subcategories include bioinformatics (39), biotechnology (112), and computational biosciences (53).
  - Under the general category “Engineering”, the Cal Poly Pomona University Library holds at least some issues of 2436 electronic or paper periodicals. Particularly relevant subcategories (which may include overlap with the previous category) include biomedical engineering (93), biotechnology (147), instrumentation (66), pharmaceutical technology (11), and quality engineering (31).
  - Under the general category “Chemistry”, the Cal Poly Pomona University Library holds at least some issues of 1359 electronic or paper periodicals. Particularly relevant subcategories (which may include overlap with the previous categories) include analytical chemistry (104), clinical chemistry (32), medicinal chemistry (39), and pharmaceutical chemistry (58).
  - Under the general category “Business, Economy and Management”, the Cal Poly Pomona University Library holds at least some issues of 3247 electronic or paper periodicals. Subcategories here are not broken down into those relevant for this endeavor.
  - Under the general category “Information Technology”, the Cal Poly Pomona University Library holds at least some issues of 1595 electronic or paper periodicals. Particularly relevant subcategories (which may include overlap with the previous categories) include Computational biosciences (85).
- Print books:

The diffuse nature of the proposed program makes it difficult to isolate expenditures or holdings that would be relevant. With a field like biotechnology it is unlikely that many books would be needed, and those that are needed and are not held by the Cal Poly Pomona University Library or one of the home campus libraries could be obtained using Interlibrary Loan services available from the home library.

d. Existing academic technology, equipment, and other specialized materials currently available.

Technology and equipment needed for the coursework already exists.
  - Available at Cal State LA for Biotech Skills I: Microcentrifuges, Thermocycler, Refrigerator, Freezer -20 C, Incubators, Sorvall benchtop centrifuge + rotor, Gel photodocumentation system, pH meter, Vortex, Plate reader, Liquid handler, Electronic multi channel pipets, per set 3, Dell computer desktop, Shaking incubator, Compound library, Biosafety cabinet, DNA electrophoresis system, Protein gel electrophoresis system, Power supply, Single channel pipets, set of 3, Water bath, Spectrometer, Heat blocks.
  - Available at Cal Poly Pomona for Biotech Skills II: ECG’s and computers, electronic supplies for the students to build their own ECG, and lab-on-a-chip kits.
  - Available at Cal State Dominguez Hills for Biotech Skills III: Tissue culture hoods, inverted microscope, digital camera with software, CO2 incubators, multiplate readers and signal screening software, DNA sequence analysis software and multiple computer workstations.

8. Additional Support Resources Required
(CPEC “Total Costs of the Program”)

Note: If additional support resources will be needed to implement and maintain the program, a statement by the responsible administrator(s) should be attached to the proposal assuring that such resources will be provided.

a. Any special characteristics of the additional faculty or staff support positions needed to implement the proposed program.

   The program will, when possible, invite qualified personnel from the industrial sector to participate in course instruction. Funds (approx. $4000/year) have been allocated in the faculty costs line to cover the cost of invited speakers. (See Attachment F, Business Plan Documents and PRBC Form, worksheet 1 (Program Revenues) and worksheet 2 (Cost Analysis).)

b. The amount of additional lecture and/or laboratory space required to initiate and to sustain the program over the next five years. Indicate any additional special facilities that will be required. If the space is under construction, what is the projected occupancy date? If the space is planned, indicate campus-wide priority of the facility, capital outlay program priority, and projected date of occupancy.

   The growth of the program is limited by laboratory capacity. Unless new laboratories can be equipped at Cal State LA and CSU Dominguez Hills, growth beyond a 24-student cohort is not expected or planned. Thus only two cohorts of 24 students are expected to be in the program simultaneously, and no additional special facilities will be needed.

c. A report written in consultation with the campus librarian, indicating any additional library resources needed. Indicate the commitment of the campus either to purchase or borrow through interlibrary loan these additional resources.

   None anticipated.

d. Additional academic technology, equipment, or specialized materials that will be (1) needed to implement the program and (2) needed during the first two years after initiation. Indicate the source of funds and priority to secure these resource needs.

   The Biotechnology Skills Series require equipment and supplies. For each of the first two years of operation, we have budgeted for $200,000 in new equipment and $15,000 in supplies for these three courses; the third year, only materials will be supported. This will cover all anticipated costs. (See Attachment F, Business Plan Documents and PRBC Form, worksheet 1 (Program Revenues) and worksheet 2 (Cost Analysis).)